General Specifications

GS 34M6H60-02E

F3NC96-0N
Positioning Module
(with MECHATROLINK-II Interface)

FA-M3

■ General

This positioning module is to be installed on the base unit of a FA–M3 range free controller system, and supports MECHATROLINK–II *1 communications.

The positioning module provides an interface (C1 master) to a high–speed motion field network based on MECHATROLINK–II, a standard proposed by Yaskawa Electric. It transmits MECHATROLINK–II commands to external equipment (slaves) according to instructions from a CPU module, and receives MECHATROLINK–II responses from external equipment.

It enables:
(1) Independent axis movement using MECHATROLINK–II commands

(2) Linear interpolation movement (starting and stopping multiple axes simultaneously)

(3) Reading of the statuses (target position, current position, etc.) of external equipment

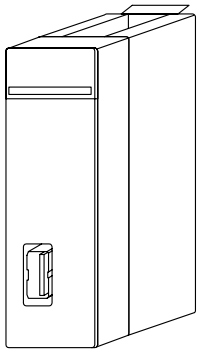
(4) Reading and writing of parameters of external equipment

*1: MECHATROLINK–II is a registered trademark of Yaskawa Electric Corporation.

■ Features

This module has the following features:

– Positioning control of up to 15 axes per module using one slot.
– Easy connection of controller and motors using connectors reduces wiring cost.
– High–speed transmission of 10 Mbps with cycle time of 1 ms for 8 axes or 2 ms for 15 axes enables control data (target position, current position, etc.) to be transmitted and received in real time to achieve fast response and synchronization of peripherals.
– Command transmission enables maximum utilization of motor performance (high speed, high resolution) to achieve fast and accurate positioning control.
– Supports versatile positioning control of multiple linear interpolation motions of up to 15 axes in any combination, as well as change in speed or target position during motion.
– Currently supports servomotors (manufactured by Yaskawa Electric). Future support for stepper motors, inverters, I/O equipment and other equipment is expected.

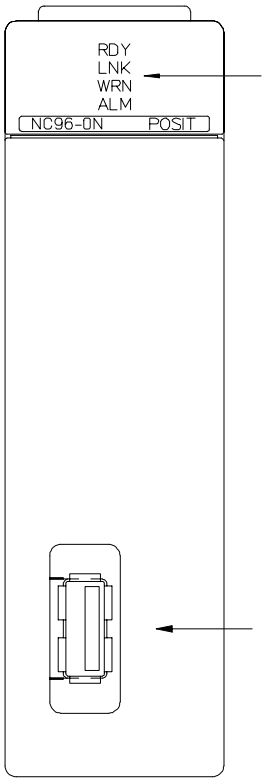


■ Specifications

Item		Specification
Interface		MECHATROLINK–II compliant
Transmission rate		10 Mbps
Transmission bytes		32 bytes
Cycle time versus number of stations		1.0 ms for up to 8 axes, 2.0 ms for up to 15 axes (user selectable)
Network Topology		Bus (multi–drop)
Communications method		Master/slave synchronous
Transmission media		2-wire shielded twisted pair cable (proprietary cable)
Maximum transmission distance		50 m (total length)
Minimum distance between stations		0.5 m
Positioning functions	Position reference	–2,147,483,648 to 2,147,483,647 (reference unit)
	Functions	– Linear interpolation movement (starting and stopping multiple axes simultaneously) – Independent axis movement using MECHATROLINK–II commands (dependant on connected external equipment and supported MECHATROLINK–II commands)
	Others	– Reading of statuses (target position, current position, etc.) of external equipment – Reading and writing of parameters of external equipment
Number of installed modules		8 modules max. (120 axes max.)
Current consumption		570 mA (5V DC)
External connection		One MECHATROLINK–II connector
External dimensions		28.9 (W) × 100 (H) × 83.2 (D) mm*2
Weight		120 g

*2: Excluding protrusions (for details, see external dimensions drawing)

■ Components and Functions

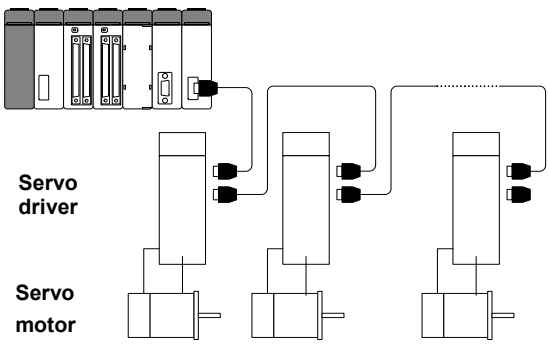


LED Indicators
RDY (green):
Lit when the internal circuit is functioning normally.
LNK (green):
Lit during MECHATROLINK-II communications.
WRN (yellow):
Lit when warning is detected by external equipment
ALM (red):
Lit when error (alarm) is detected by the module or external equipment

MECHATROLINK-II Connector
For communications with MECHATROLINK-II-compliant external equipment through a special cable

■ System Configuration Example

FA-M3



■ External Connection Diagram

Connector Specifications

Pin No.	Signal	Function
1	–	Not connected
2	/S	Serial data input/output
3	S	
4	–	Not connected

Note: The connector shell is connected to the FG terminal.
Internal circuitry is insulated using a pulse transformer.
A built–in130 Ω terminating resistor is installed between the /S and S signals.

■ Operating Environment

This module is compatible with the following CPU modules.

CPU Modules	Style Code and ROM Version
F3SP28–3N, F3SP38–6N F3SP53–4H, F3SP58–6H	Rev.7 or later
Other CPUs	No restriction

■ Model and Suffix Codes

Model	Suffix Code	Style Code	Option Code	Description
F3NC96	- 0N	—	—	15 axes Supports MECHATROLINK–II communications

■ Compatible External Equipment

Products of Yaskawa Electric Corporation:

– ∑–III series SGDS–□□□1□A SERVOPACK
– ∑–II series SGDH–□E SERVOPACK
SGDH–□E SERVOPACK must be installed with MECHATROLINK–II Application Module (JUSP–NS115).

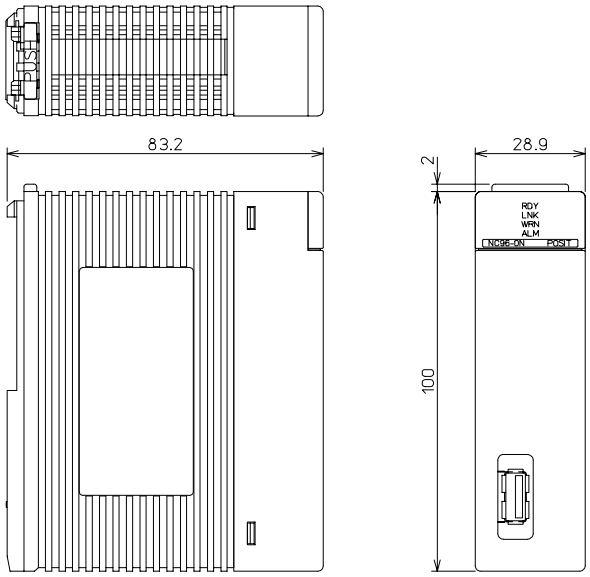
■ Communications Cable/Terminator

Products of Yaskawa Electric Corporation:

Type	Model Code
MECHATROLINK–II communications cable	JEPMC–W6002–□□
	JEPMC–W6003–□□

Type	Model Code
MECHATROLINK–II terminator	JEPMC–W6022

■ External Dimensions



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■ Functional Overview

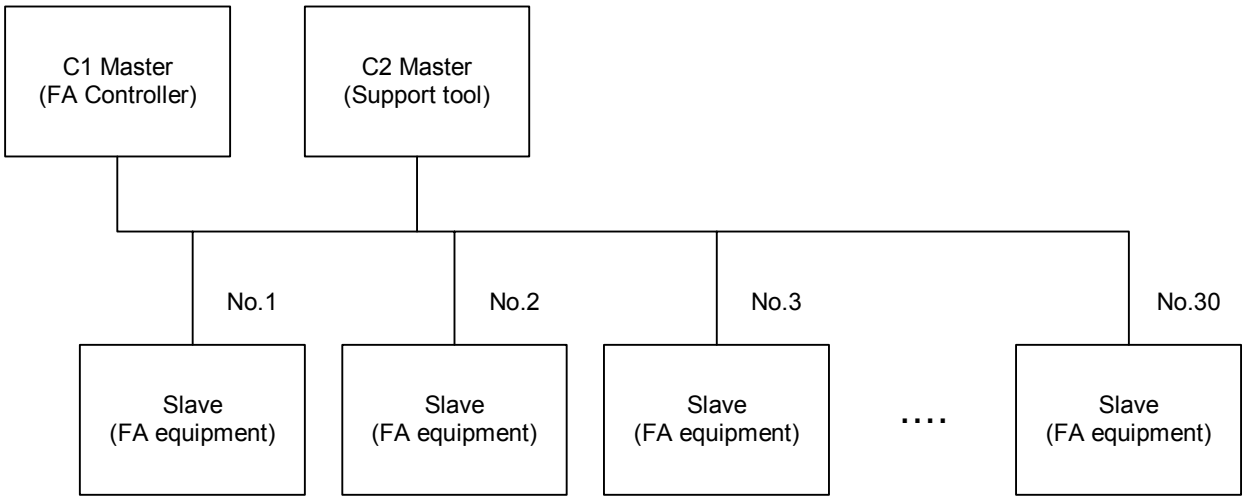
1. What is MECHATROLINK–II Communications?

MECHATROLINK–II communications is an open architecture, high–speed motion field network proposed by Yaskawa Electric Corporation, which enables distributed control of multiple FA units (servo systems, inverters, I/O modules, etc.) by one FA controller.

Compared to MECHATROLINK–I, the MECHATROLINK–II transmission specification provides for higher speed (10 Mbps versus 4 Mbps) and additional functions.

MECHATROLINK–II has the following features:
– Synchronous communications through cyclic transmission
– High speed transmission of 10 Mbps
– Communications cycle time options allow optimization based on the number of connected stations and transmission volume. This module provides two communications cycle time options: 1 ms for 8 axes or 2 ms for 15 axes.
– Reduced wiring cost through the use of a single shielded twisted–pair interface cable
– Low FA controller load as transmission control by the Transmission LSI manufactured by Yaskawa Electric includes error detection and retransmission within a communications cycle.
– Allows other FA support tools to be connected to a FA controller, acting as the master.

MECHATROLINK–II communications allows one C1 master to be connected to a maximum of 30 slaves and an optional C2 master. (The positioning module itself supports connection to a maximum of 15 slaves.)



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2. Module Operation

This positioning module is to be installed on the base unit of a FA–M3 range free controller system, and supports MECHATROLINK–II communications.

The positioning module provides an interface (C1 master) to a high–speed motion field network based on MECHATROLINK–II, a standard proposed by Yaskawa Electric. It transmits MECHATROLINK–II commands to external equipment (slaves) according to instructions from a CPU module, and receives MECHATROLINK–II responses from external equipment.
It enables:

(1) Independent axis movement using MECHATROLINK–II commands

(2) Linear interpolation movement (starting and stopping multiple axes simultaneously)

(3) Reading of the statuses (target position, current position, etc.) of external equipment

(4) Reading and writing of parameters of external equipment

■ Independent axis movement using MECHATROLINK–II commands

The procedure for initiating a positioning movement by sending a MECHATROLINK–II command is given below.

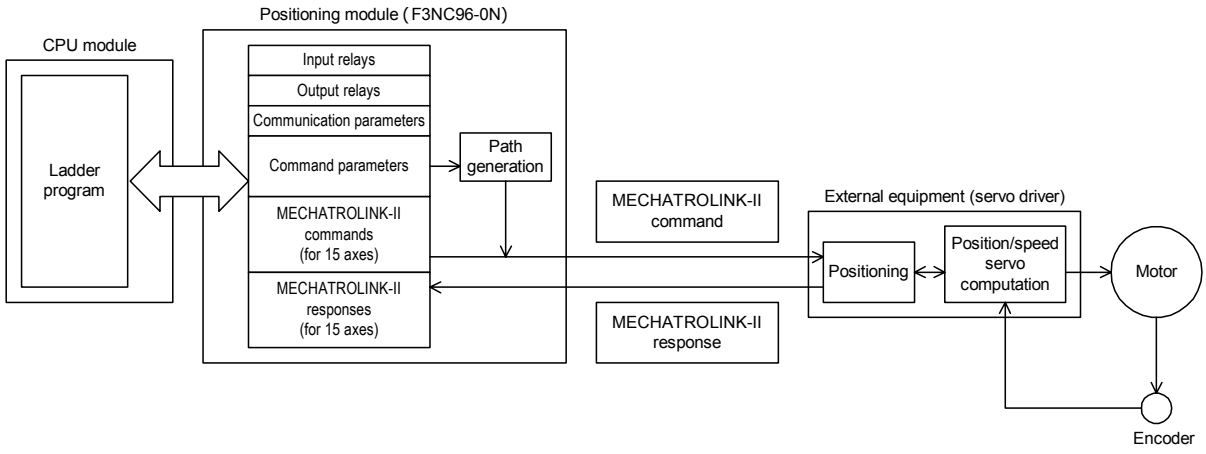
– From the CPU module, a program writes the command code ($35) for positioning command (POSING: $35), as well as other command parameters such as target position (reference unit) and target speed (reference unit/s) to the command parameters area.
– After writing completes, the program turns on the Send Command output relay. The corresponding MECHATROLINK–II command is transmitted to the external equipment (e.g. servo driver) to initiate the desired positioning movement in the external equipment.
– The Response Received input relay turns on when a response to the transmitted MECHATROLINK–II command is received.
– The Positioning Completed input relay turns on subsequently when the positioning movement completes.

The acceleration/deceleration curve and acceleration/deceleration constants are preset in the external equipment (e.g. servo driver) using parameters.

■ Linear interpolation movement (starting and stopping multiple axes simultaneously)

The procedure for performing linear interpolation is given below.

– From the CPU module, a program writes the command code ($100) for the interpolation command, as well as other command parameters for the interpolation movement such as acceleration time (in ms), deceleration time (in ms), interpolation axes, target position (reference unit) and target speed (reference unit/s) to the command parameters area.
– After writing completes, the program turns on the Send Command output relay. The module computes the target position at each communications cycle, and transmits the computed target position to all external equipment involved in the linear interpolation movement simultaneously using MECHATROLINK–II commands to initiate the desired positioning movement.
– The Response Received input relay turns on when positioning movement begins.
– The Positioning Completed input relay turns on subsequently when positioning movement completes.



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3. Scope of MECHATROLINK–II Support

This section lists the MECHATROLINK–II commands that are executable by the module.

◎: Executable by a user using axis MECHATROLINK–II command parameters.

○: Executable by a user using extended MECHATROLINK–II command parameters.

△: Not executable by a user but is executed automatically by the positioning module or external equipment.

×: Not supported

■ MECHATROLINK–II Common Commands

Command Code	Command	Function	Processing Classification	Synchronous Classification	Subcommand	Supported?
$00	NOP	No operation	N	A	Yes	◎
$01	PRM_RD	Read parameter	D	A	No	◎
$02	PRM_WR	Write parameter	D	A	No	◎
$03	ID_RD	Read ID	D	A	Yes	○
$04	CONFIG	Set up device	C	A	No	◎
$05	ALM_RD	Read alarm or warning	D	A	No	○
$06	ALM_CLR	Clear alarm or warning	C	A	No	◎
$07	–	–	–	–	–	–
$08	–	–	–	–	–	–
$09	–	–	–	–	–	–
$0A	–	–	–	–	–	–
$0B	–	–	–	–	–	–
$0C	–	–	–	–	–	–
$0D	SYNC_SET	Start synchronous communications	N	A	No	◎
$0E	CONNECT	MECHATROLINK–II connection	N	A	No	△
$0F	DISCONNECT	Disconnect	N	A	No	△
$10	–	–	–	–	–	–
$11	–	–	–	–	–	–
$12	–	–	–	–	–	–
$13	–	–	–	–	–	–
$14	–	–	–	–	–	–
$15	–	–	–	–	–	–
$16	–	–	–	–	–	–
$17	–	–	–	–	–	–
$18	–	–	–	–	–	–
$19	–	–	–	–	–	–
$1A	–	–	–	–	–	–
$1B	PPRM_RD	Read non–volatile parameter	D	A	No	×*1
$1C	PPRM_WR	Write non–volatile parameter	D	A	No	◎
$1D	–	–	–	–	–	–
$1E	–	–	–	–	–	–
$1F	–	–	–	–	–	–

*1: This command is not executable because it is not supported by the ∑III series SGDS–□□□1□A SERVOPACK.

■ MECHATROLINK–II Common Motion Commands

Command Code	Command	Function	Processing Classification	Synchronous Classification	Subcommand	Supported?
$20	POS_SET	Set coordinates	D	A	No	◎
$21	BRK_ON	Apply brake	C	A	No	◎*2
$22	BRK_OFF	Release brake	C	A	No	◎*2
$23	SENS_ON	Turn sensor ON	C	A	No	◎
$24	SENS_OFF	Turn sensor OFF	C	A	No	◎
$25	HOLD	Stop motion	M	A	Yes	◎
$26	MLOCK_ON	Machine lock ON	C	A	Yes	×*1
$27	MLOCK_OFF	Machine lock OFF	C	A	Yes	×*1
$28	LTMOD_ON	Request latch mode	C	A	Yes	◎
$29	LTMOD_OFF	Release latch mode	C	A	Yes	◎
$2A	–	–	–	–	–	–
$2B	–	–	–	–	–	–
$2C	–	–	–	–	–	–
$2D	–	–	–	–	–	–
$2E	–	–	–	–	–	–
$2F	–	–	–	–	–	–

*1: These commands are not executable because they are not supported by the ΣIII series SGDS–□□□1□A SERVOPACK.

*2: Apply or release brake by operating the external equipment itself.

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■ MECHATROLINK–II Standard Servo Commands

Command Code	Command	Function	Processing Classification	Synchronous Classification	Subcommand	Supported?
$30	SMON	Status monitoring	D	A	Yes	◎
$31	SV_ON	Turn servo ON	C	A	Yes	◎
$32	SV_OFF	Turn servo OFF	C	A	Yes	◎
$33	–	–	–	–	–	–
$34	INTERPOLATE	Interpolation feed	M	S	Yes	△
$35	POSING	Positioning	M	A	Yes	◎
$36	FEED	Constant speed feed	M	A	Yes	◎
$37	–	–	–	–	–	–
$38	LATCH	Interpolation feed with position detection	M	S	Yes	×
$39	EX_POSING	External input positioning	M	A	Yes	◎
$3A	ZRET	Home	M	A	Yes	◎
$3B	–	–	–	–	–	–
$3C	VELCTRL	Velocity control	M	A	Yes	◎
$3D	TRQCTRL	Torque control	M	A	Yes	◎
$3E	ADJ	Adjust	D	A	No	○
$3F	SVCTRL	General–purpose servo control	X	S, A	Yes	×

Processing Classification and Synchronous Classification

Symbol	Processing Classification
N	Network commands
D	Data communications commands
C	Control commands
M	Motion commands
X	Compound commands

Symbol	Synchronous Classification
S	Synchronous
A	Asynchronous

■ MECHATROLINK–II Subcommands

Command Code	Command	Function	Supported?
$00	NOP	No operation	△
$01	PRM_RD	Read parameter	×
$02	PRM_WR	Write parameter	×
$05	ALM_RD	Read alarm or warning	×
$1B	PPRM_RD	Read non–volatile parameter	×*1
$1C	PPRM_WR	Write non–volatile parameter	×
$28	LTMOD_ON	Request latch mode	×
$29	LTMOD_OFF	Release latch mode	×
$30	SMON	Status monitoring	△

*1: This command is not executable because it is not supported by the ∑III series SGDS–□□□1□A SERVOPACK.

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4. Overview of Positioning Functions

The positioning module (with MECHATROLINK–II support) provides MECHATROLINK–II command positioning functions using a MECHATROLINK–II communications interface, as well as interpolation movement command positioning functions, which compute and send position references required for implementing an interpolation movement.

4.1 MECHATROLINK–II Command Positioning Functions

This section describes the positioning functions of MECHATROLINK–II commands that are executable by the module.

For details on the operation of each of these commands, as well as other MECHATROLINK–II commands, refer to the relevant manuals published by Yaskawa Electric Corporation, as given in the table below.

Document Name	Document Number	Description
Σ–III SeriesSGM□S/SGDS User's Manual for MECHATROLINK–II Communications	SIES80000011B	Describes the SGDS type SERVOPACK.
Σ–II Series SGM□H/SGDH User's Manual	SIES80000005C	Describes the SGDH type SERVOPACK.
Σ–II Series SGDH MECHATROLINK–II Application Module User's Manual	SIEC71080001C	Describes the application module for MECHATROLINK–II communications.

■ Positioning Command (POSING: $35)

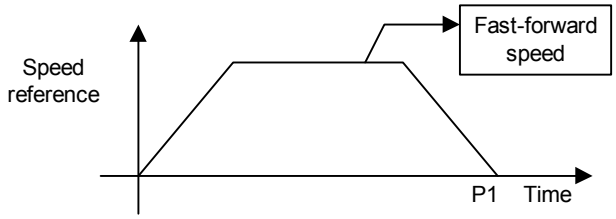
This command performs positioning movement to a given position reference.

As shown in the figure below, the command moves an axis to a target position (P1) using a specified fast–forward speed.

The speed and position data can be changed during execution by sending a command that contains modified reference values.

If the new position provides inadequate allowance for the deceleration distance, or if the new position is in the reverse direction relative to the current movement direction, the module decelerates and stops the movement (the DEN status remains at zero) before initiating positioning to the new position.

To check for execution completion, check that the Output Completed (DEN) status=1.



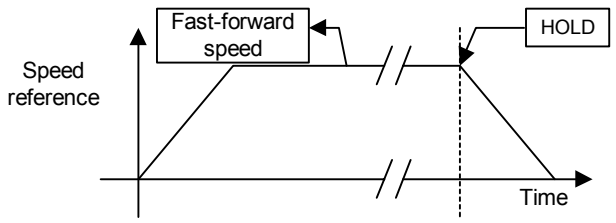
Speed Reference of Positioning Command (POSING: $35)

■ Constant Speed Feed Command (FEED: $36)

This command executes constant speed movement at a specified feed speed. The figure below shows the movement curve.

Executing the Stop Motion command (HOLD: $25) decelerates and stops the movement. The speed and direction can be changed during execution by sending a command containing modified reference values. If a change in movement direction is required, the module decelerates and stops the axis before initiating movement in the reverse direction.

To check for execution completion, check that the Output Completed (DEN) status=1.



Speed Reference of Constant Speed Feed Command (FEED: $36)

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■ Stop Motion Command (HOLD: $25)

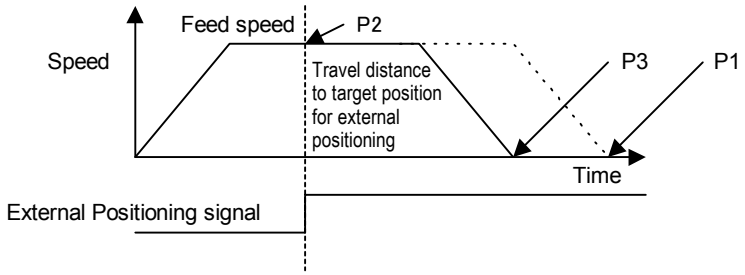
This command stops movement according to a deceleration pattern, which can be specified using command options. To check for execution completion, check that the Output Completed (DEN) status=1.

■ External Input Positioning Command (EX_POSING: $39)

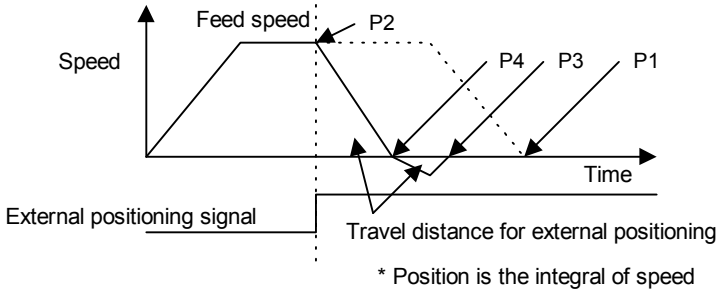
This command executes fast–forward movement according to the External Positioning Signal input.

When the external positioning signal input goes high, the module latches the current counter position, then moves, decelerates and stops the axis, by traveling through a distance specified by a parameter. If the distance required for deceleration to rest is shorter than the specified distance, the module decelerates and stops the movement according to the deceleration pattern and then executes a return to the target position before ending command execution. The figures below show the operation sequences of an External Input Positioning command executed under different initial movement conditions.

To check for execution completion, check that the Output Completed (DEN) status=1.



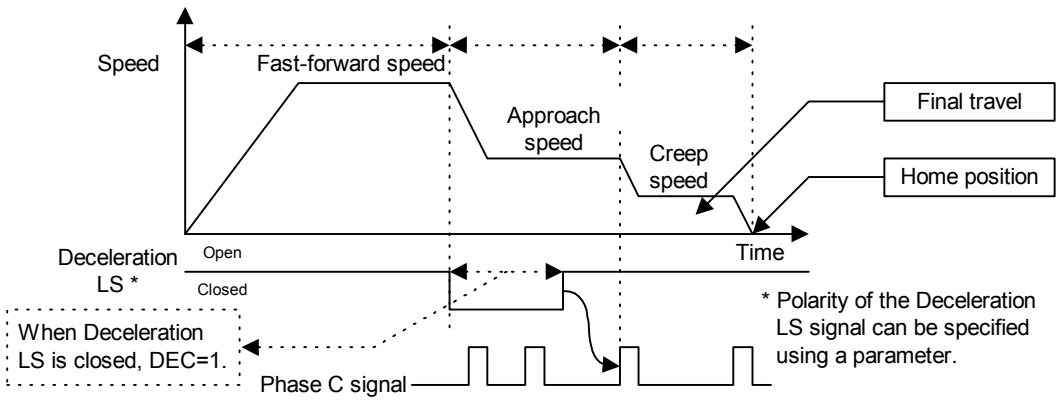
Speed Reference for External Input Positioning Command (EX_POSING: $39)



Speed Reference When Specified Travel for External Input Positioning is Insufficient for Deceleration

■ Home Command (ZRET: $3A)

This command executions a return to the home position using the Deceleration LS and Latch signals. The Latch Signal parameter determines the latch signal to be used. To check for execution completion, check that the Output Completed (DEN) status=1.



Homing Sequence at Driver End (when using Phase C signal)

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4.2 Interpolation Command Positioning Functions

This section describes the positioning functions of interpolation commands that are executable by the module.

■ Start Positioning ($0100)

This command executes linear interpolation movement (starting and stopping multiple axes simultaneously) for up to 15 axes.

The axis from which the command is issued is known as the "reference axis" (or command axis), while the other axes involved in the interpolation movement are known as "interpolation axes".

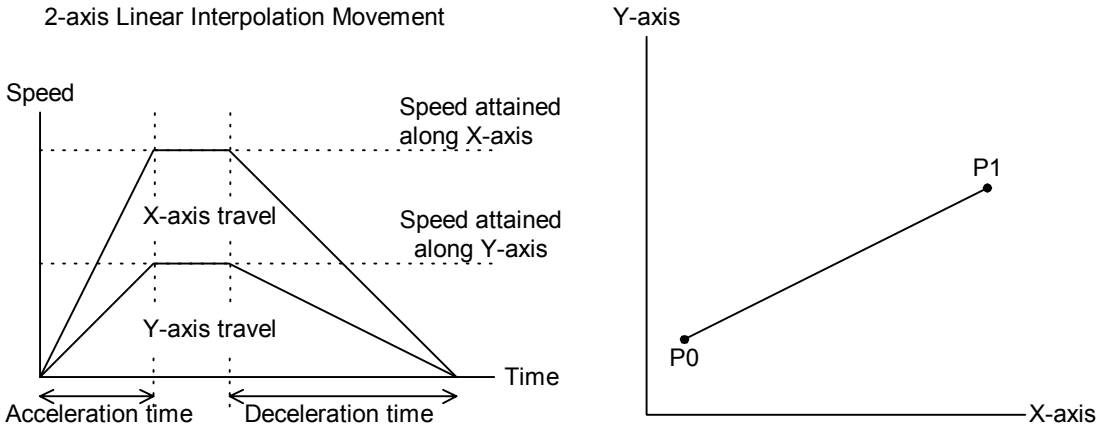
Interpolation axes are specified using the Interpolation Axes parameter of the reference axis at the time of command execution.

While a linear interpolation movement is in progress, another linear interpolation movement can be executed using a different set of axes, which are at rest. Up to 15 axes can be made to move this way. Executing two or more linear interpolation movements with overlapping sets of axes is, however, not allowed.

Target position and speed must be specified for each movement axis (reference axis and interpolation axes). In order that all movement axes can stop at the same time, this module computes the required speed of each axis to accommodate the axis that requires the longest travel time (as detected by the module). Each axis then moves according to its required speed, regardless of its specified speed.

To stop a linear interpolation movement in progress, execute a Decelerate and Stop command ($0200) or a Stop Immediately command ($0300) against the reference axis, which is the axis from which the Start Positioning command was originally issued.

To change the speed or target position during a linear interpolation movement, execute a Change Speed command ($0400) or a Change Target Position command ($0500) against the reference axis, which is the axis for which the Start Positioning command was originally issued.



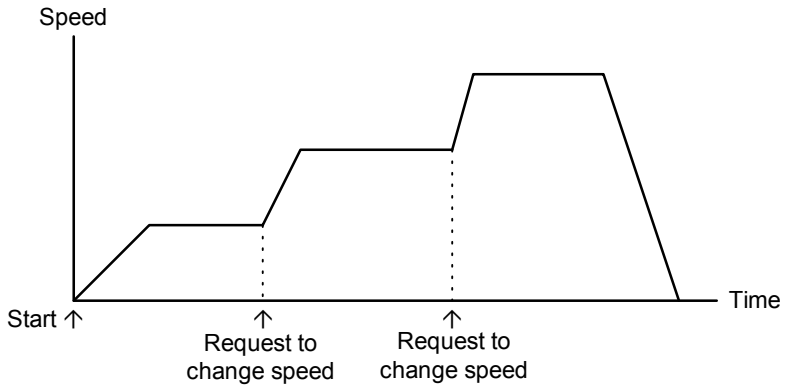
Linear Interpolation Movement Initiated by Start Positioning Command

■ Change Speed ($0400)

This command can be executed to change the speed of moving axes during a linear interpolation movement.

Changing the set of movement axes during linear interpolation movement is, however, not allowed.

When the axes approach the target position after a speed change, they decelerate and stop according to the deceleration time specified in the Change Speed command.



Speed Change Movement Initiated by Change Speed Command

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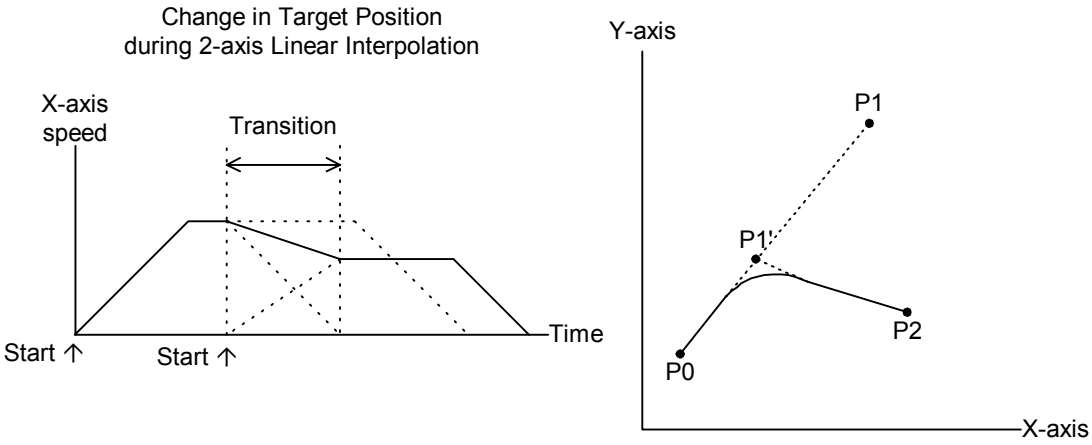
■ Change Target Position ($0500)

The Change Target Position command is executed to change the target position during a linear interpolation movement.

Changing the set of movement axes during linear interpolation movement is, however, not allowed. The target speed can also be changed together with the target position using a Change Target Position Command.

Executing the Change Target Position command in 'positioning completed' state starts positioning.



Target Position Change Movement Initiated By Change Target Position Command

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